



The Role of Ethanol as an Energy Solution

(in 15 Minutes)

Prepared by REAP Coalition
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The “Great” Ethanol Debate



- Energy Balance
- *Air Quality* ←
- Food versus Energy
- Too Many Subsidies
- Pesticide & Land Use

What is Ethanol?

- **Pure Ethanol versus Pure Gasoline**
 - Lower Sulfur
 - Lower Toxicity
 - Lower Vapor Pressure
 - Biodegradable & Domestic Energy Source
 - Potential GHG Solution for Transportation
 - Great Potential as Energy/Economic Driver
- **Problems Come from Blending**
 - RVP Jumps
 - Permeation Increases (but not caused by ethanol)

Adding Ethanol to Gasoline

- Perceived Emissions Reductions

- Tailpipe VOC
 - Carbon Monoxide
 - Potency-Weighted Toxics
 - Particulate Matter (PM)
 - Greenhouse Gases (esp. with new feedstocks)
- } Total Hydrocarbons (CA)

- Perceived Emissions Increases

- NO_x
- Permeation (Evaporative VOC)

Taking Ethanol Out of Gasoline

- Perceived Emissions Increases

- Tailpipe VOC
 - Carbon Monoxide
 - Potency-Weighted Toxics
 - Particulate Matter (PM)
 - Greenhouse Gases
- } Total Hydrocarbons (CA)

- Perceived Emissions Reductions

- NO_x
- Permeation (Evaporative VOC)

The Point: Tradeoffs

- **Fuel Change = Emissions Profile Change**
 - Different blends have different strengths/weaknesses
 - True for ethanol, true for nearly all blend changes
 - We're only focusing on a few??!! PM? GHG?
- *“Cannot support fuel that increases any one pollutant”* is not a realistic position
- **Solution: Responsible Use**
 - Definition may be different in different regions
 - Influenced by SIP

Full Weight of Evidence

- **Regulatory Models: Strengths & Weaknesses**
 - CA Predictive Model does not include offroad, and is not a “predictive model” for other states
- **Airshed Models: Most Sensitive**
 - Ethanol does very well in UAM and CAMx Runs
 - Even when adjusted for permeation
- **Air Monitoring Data: It is Relevant**
 - AQ improved in places switching from MTBE to Ethanol
 - CA, NY, CT, WI, etc.

Connecticut & New York

Connecticut Monitoring Data

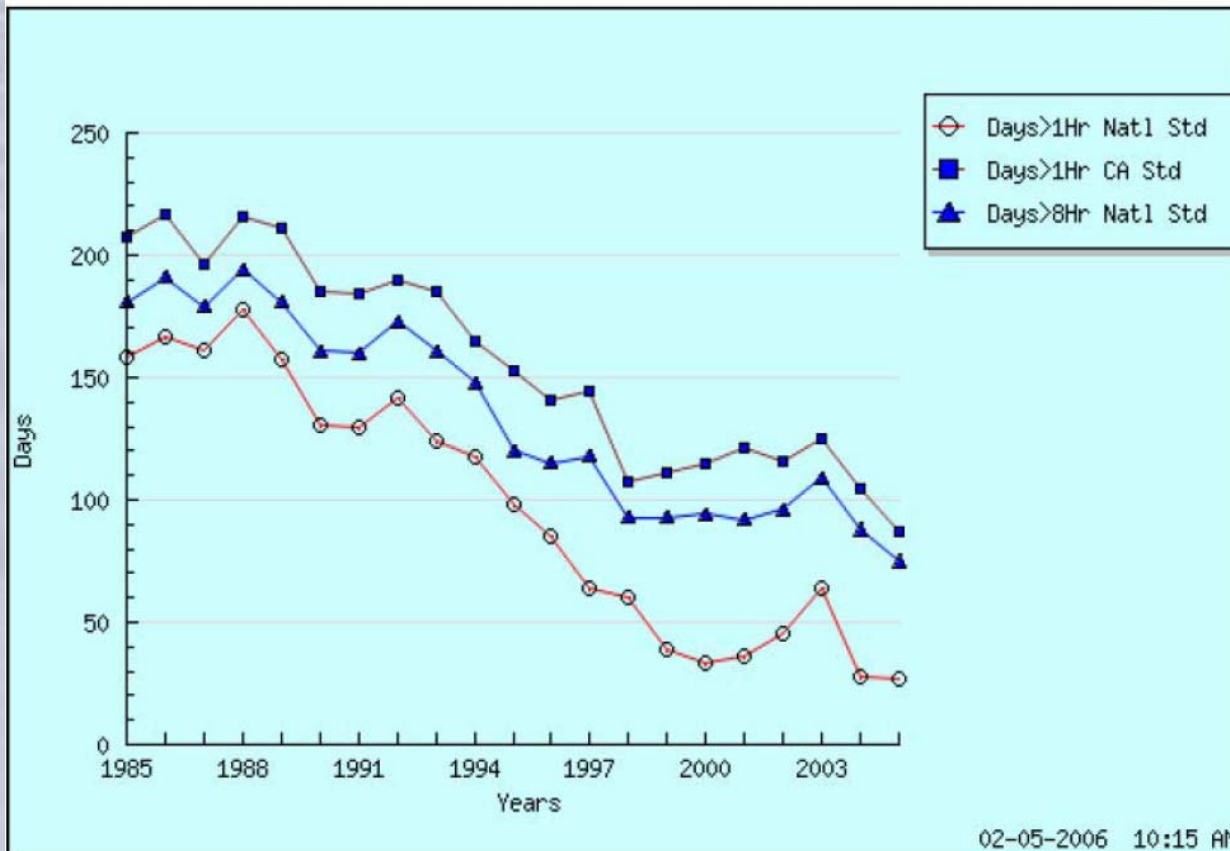
	1998	1999	2000	2001	2002	2003	2004	2005
8-hour Ozone Exceedance Days	25	33	15	26	36	14	6	20
1-hour Ozone Exceedance Days	5	11	3	9	13	6	1	7

New York Monitoring Data

	1998	1999	2000	2001	2002	2003	2004	2005
8-hour Ozone Exceedance Days	14	20	7	17	28	15	1	10

California (South Coast)

Ozone Trends Summary: **South Coast Air Basin**
8-Hour Ozone Planning Area





Permeation: The Science

- “Permeation” is an evaporative VOC
- Different fuels have different VOC profiles
- E-blends: Higher Permeation & Lower Tailpipe VOC
- Very Recent Data Observations:
 - Very manageable for on-road
 - Permeation does not increase going from E6 to E10
 - Reactivity of e-blend permeate lower than E0 permeate
 - Hypothetical Result: E10 a more attractive option
- < 20 tpd statewide in California; ~ 13 tpd in 2020

Permeation: Some Context

- **Original CA Estimate: > 50 tpd statewide**
- **New Estimate: < 20 tpd statewide; 3.7 tpd S. Coast by 2020**
 - **Decreases over time as newer vehicles become more prevalent**
- **13 tpd already accounted for by CA Predictive Model**
- **The New Cloud: Off-Road Permeation**
 - **One Lawn Mower Test**
 - **Flagged by California, but not dealt with**
 - **Offroad permeation is only part of the offroad picture**

NO_x: The Science

- **ARB: E10 Increases NO_x ~ 5%**
- **EPA Complex Model: Very Small NO_x increase from E10**
- **Our Perspective:**
 - Likely a small NO_x response that can be blended out if necessary
 - NO_x impact very uncertain; should not block good policy
- **Other Realities:**
 - 5% On-Road NO_x Increase = < 1% of total NO_x inventory in CA
 - Adjusting sulfur content impacts NO_x emissions
 - Adjusting olefin content impacts NO_x emissions

NO_x: Some Context

- U.S. EPA:

“[i]t should be noted that the magnitude of the NO_x response to [ethanol], even as predicted by the [California Model], is not large when compared to NO_x emission differences between vehicles, or test-to-test variability in emissions . . . [t]he small size of the [ethanol] effect on NO_x emissions indicated in all of these models makes it difficult to detect statistically and to quantify precisely.”

NO_x: More Context

- Coordinating Research Council (2006)

“[t]he results in the literature show some tendency for NO_x emissions to increase with greater ethanol levels, but this trend is not consistent *or statistically significant* over a wide range of studies.”

- 2006 E-67 Study

A Word About High Blends (E85)

- **Ethanol's Attributes More Visible**
- **Market Penetration Rate Slower**
 - **Requires Vehicle Changes & Retail Outlet Changes**
 - **How best to catalyze this change?**
- **Different Economics for Ethanol Industry**
 - **Low Blend Market Important for Industry**
- **E85 is a marketing more than market term**



Summary

- Ethanol here to stay as an energy solution, with great potential to reduce GHG emissions
- Can be used responsibly, within SIP & regulatory requirements, even with NO_x and permeation
- Fuels diversification will improve air quality, irrespective of some limited modeling scopes
- Alarmist views of ethanol are counter-productive, and energize the status quo